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and the details of the method employed are indicated.

14. *Mitosis in Trichomonas*: C. A. KOFOD and O. SWEZY, Zoological Laboratory, University of California.

The authors conclude that cell-division in trichomonad flagellates is a true mitosis with differentiated chromosomes, which split longitudinally prior to their location in the equatorial plate; that the nuclear membrane persists throughout mitosis; that the paradesmose between the migrating blepharoplasts is extranuclear at all times, disappears after nuclear division, and does not give rise to the axostyle; and that the axostyle splits longitudinally and thus forms two daughter axostyles.

The number concludes with the report of the annual meeting (which has already appeared in *SCIENCE*) by the home secretary, and with announcements of the research grants made from the trust funds of the academy during the preceding year.

#### SPECIAL ARTICLES

##### THE CONTINUOUS SPECTRA OF GASES

IN spectroscopic literature there are many casual references to a continuous background in the vacuum-tube spectra of various gases, such as oxygen, chlorine, etc. Usually these observations appear to have been confined to the visible region, and I can recall no comments on continuous spectra in the ultra-violet except in the case of hydrogen. Schniederjost<sup>1</sup> and Friederichs<sup>2</sup> observed such a spectrum at low pressures, which extended to a wave-length of about 2,100. The latter attempted to use the uncondensed discharge through a small capillary tube at about 2 mm. pressure as a source for the photography of absorption spectra, but found that the results were unsatisfactory, even with exposures varying from twelve to twenty-four hours.

In photographs of the hydrogen spectrum obtained with a large two-prism quartz spectrograph I have frequently observed this continuous spectrum. Although the resolving power of this spectrograph in the extreme ultra-

violet is greater than that of a five-inch grating in the first order, there is no evidence of resolution into lines or bands. The spectrum appears to be uniformly continuous, and it seems likely that its gradual fading out in approaching the wave-length 2,100 is due rather to the absorption of the thick quartz system than to the lack of these wave-lengths in the emitted light. It appears to be due to pure hydrogen, for successive improvements in purity due to the removal of oxygen, water vapor, and nitrogen cause no noticeable change; nor does the addition of a trace of oxygen to hydrogen previously freed from that gas as far as possible cause any appreciable difference.

It seems very unlikely that a continuous spectrum can arise from free vibrations within the atom or molecule, hence it has been usually ascribed to molecular collisions. In comparing different gases at the same pressure, the number of collisions would depend mostly on the mean velocity of the molecules, so that the number of collisions would rapidly diminish as the molecular weight increases; hence we might expect that the continuous spectrum of a light gas would be stronger than that of a heavier gas. This was found to hold good for hydrogen, helium and neon. Photographs were obtained of the spectra of these three gases in vacuum tubes prepared by Hilger. The pressure was about the same in all. With a two-minute exposure, the continuous spectrum of hydrogen was very intense; that of helium about half as strong, and that of neon about one third as strong. They all extended to about the same limit—that set by the transparency of the quartz. In all these cases the uncondensed discharge of a medium-sized induction coil was used. The introduction of a condenser almost completely obliterated the continuous spectrum. When a condenser is used the radiation probably comes from dissociated ions, with free periods little disturbed by molecular collisions.

Nitrogen, krypton and xenon did not show any continuous spectrum.

Some tests showed that hydrogen tubes may render excellent service as sources for the

<sup>1</sup> Schniederjost, *Zt. f. Wiss. Phot.*, p. 265, 1904.

<sup>2</sup> Friederichs, *Bonn Diss.*, 1905.

study of absorption spectra in the ultra-violet. It was not found advisable to use capillary tubes, nor to work at such low pressures as Friederichs did. The best results were obtained with end-on tubes, from 5 to 10 mm. in diameter and about 30 cm. long, with quartz windows, and at pressures in the neighborhood of 5 mm. The necessary exposure varies from 5 minutes to an hour, according to the width of the slit, the absorptive power of the medium, etc. I have obtained a beautiful photograph of the absorption spectrum of benzol vapor with fifteen minutes' exposure.

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UNIVERSITY OF CALIFORNIA,  
May 18, 1915

#### THE IOWA ACADEMY OF SCIENCE

THE twenty-ninth annual session of the Iowa Academy of Science was held in the Hall of Physics, State University of Iowa, Iowa City, on April 30 and May 1, 1915. Over one hundred members were registered. At the opening session on Friday afternoon, after the transaction of preliminary business, the president, Professor H. S. Conard, called for the presentation of papers of general interest. At 4 P.M. the academy separated into sections for the further reading of papers as follows: section one, botany; section two, physics, chemistry and mathematics; section three, zoology, geology, psychology, medicine.

Professor Ellery W. Davis, of the department of mathematics in the University of Nebraska, gave the annual address on the subject "Uncertainties," a discussion of the foundations of exact knowledge.

On Saturday morning the sections resumed their meetings, except that the Iowa section of the American Chemical Society met independently. At the business meeting the following officers were elected for the coming year.

*President:* Harry M. Kelly, Mount Vernon.

*First Vice-president:* G. W. Stewart, Iowa City.

*Second Vice-president:* Charles R. Keyes, Des Moines.

*Secretary:* James H. Lees, Des Moines.

*Treasurer:* A. O. Thomas, Iowa City.

The sectional meetings were so successful that a continuation of the plan was decided upon for the next annual meeting.

Luncheons were enjoyed on Friday evening by the geologists and geographers as guests of Dr.

and Mrs. Kay, by the mathematicians and by the physicists. A general luncheon was participated in by the members of the academy on Saturday noon, following the business session.

#### Program

(Abstracts are by the authors.)

*Preliminary Notes on Nectar Production:* L. A. KENOYER.

*An Anomalous Hickory-nut; An Exobasidium on Armillaria; The Role of Soil Fungi:* GUY WEST WILSON.

*The Forest and Shrub Flora of Western Iowa:* L. H. PAMMEL, G. B. MACDONALD AND H. B. CLARK.

This paper discussed the distribution of trees and shrubs of the drainage basin of the Missouri River and some of its tributaries. A number of southern species like *Cercis canadensis* and *Asimina triloba*, *Quercus acuminata* and *Vitis cinerea* reach their northern distribution in Fremont County.

*The Weed Flora of the Lake Superior Region Compared with the Weed Flora of Iowa:* L. H. PAMMEL.

A brief comparative study of the distribution of weeds of the northern lake region and the prairie region of Iowa.

*Some Comparative Germination Tests of Sweet Clover:* H. S. DORY.

A test of the germination of sweet clover treated with sulphuric acid, scratching, freezing and the Hughes method. It was found that scarification, freezing and the acid hastened the germination of seeds.

*The Flora of the Ledges, Boone County, Iowa:* WM. DIEHL, presented by L. H. PAMMEL.

A systematic catalogue of the spermatophytes and ferns of the ledges comprising a small area of Carboniferous sandstone along Pease Creek, a small stream which empties into the Des Moines. In this region occur a number of species of local range like *Quercus acuminata*, *Dirca palustris*, *Juniperus virginiana*, *Physocarpus opulifolius*, *Lathyrus ochroleucus*, *Trillium nivale*, etc.

*The Flora of the East Slope of the Cascade Mountains in Crook County, Oregon:* MORTON E. PECK.

The paper discusses briefly the general distribution of the flora on a line drawn across the Cascade Mountains in central Oregon, then takes up more in detail the plants occurring on the lower portion of the eastern slope, namely, at the town of Sisters. A study of these indicates that the locality is